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**Application  
for  
United States  
Letters Patent**

filed on behalf of

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For: System and Method for Assessing  
Healthcare Risks  
Attorney Docket: 069090.1

**PATENT**

**SYSTEM AND METHOD FOR ASSESSING HEALTHCARE RISKS**

**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] Not Applicable.

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**STATEMENT REGARDING FEDERALLY SPONSORED-RESEARCH OR DEVELOPMENT**

[0002] Not Applicable.

10 **INCORPORATION BY REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC**

[0003] Not Applicable.

**FIELD OF THE INVENTION**

15 [0004] The invention disclosed broadly relates to the field of methods for assessing risk and more particularly relates to the field of assessing the risks for issuing healthcare insurance.

**BACKGROUND OF THE INVENTION**

20 [0005] Assessing member health risk has become a critical need of healthcare organizations. An individual's health risk or "illness burden" is a measure of the relative resources expected to be required for their medical care. It can vary for a number of reasons, including a person's current health, genetic make-up, socio-economic status, and environment. Whether to support accurate payment rates,  
25 meaningful comparisons of provider performance, or the identification of patients of

highest risk, sound methods of health risk assessment are an important tool for any health care organization.

[0006] Adjusting for differences in health risk can be thought of as a two-step process.

5 The first step, *risk assessment*, involves the measurement of the expected health care costs or utilization of an individual or groups of individuals. *Risk adjustment* is the mechanism for adjusting for differences in risk, as measured by the risk assessment. In all applications, risk adjustment will only be as good as the underlying risk assessment method. There is a need for a new approach to health risk assessment.

10 SUMMARY OF THE INVENTION

A method for assessing risk of insuring a healthcare patient, the method comprises steps of: receiving demographic data on a patient and data on at least one pharmacy service prescribed for the patient; assigning a unique drug class to each pharmacy service; using the unique drug classes for ordering the pharmacy services according to  
15 a predetermined hierarchy of classes; and providing a risk score for the patient using the ordered pharmacy services.

[0007] BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a block diagram providing an overview of a process according to an  
20 embodiment of the invention.

[0009] FIG. 2 shows a drug code hierarchy for use in a method according to the invention.

25 [0010] FIGs. 3a-c show a first table listing pharmacy risk groups.

[0011] FIG. 4 shows a second table illustrating examples of PRG Risk Score Assignment.

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#### DETAILED DESCRIPTION

[0012] Referring to FIG.1, there is shown a block diagram providing an overview of a process according to an embodiment of the invention. The method can be implemented as software executed by any suitable information processing system.

- 10 The method discussed herein uses a set of risk groups (identified by the trademark “PRC”) to provide a solution to overcome the detriments of present systems. PRGs use a patient’s pharmaceutical prescriptions and demographic information to assess their prospective health risk. PRGs is designed to assist organizations that do not have access to medical claims or desire to perform more timely health risk assessment.
- 15 Although medical claims can provide advantages in measuring patient risk there is a need for a method for assessing risks in health care that avoids the detriments of claims-based assessment. In particular, the fundamental building blocks of PRGs are a patient’s mix of pharmacy prescriptions – the unique occurrences of a drug used in treating a disease or condition and how that agent relates to others prescribed for the
- 20 patient. The nature and mix of these treatments provides a pharmacy-based clinical profile for a patient that can serve as a marker of his/her future need for medical care. The method comprises the following elements:

1. Drug Code Hierarchy – Using the NDC codes recorded on pharmacy claims and a  
25 hierarchy developed by Symmetry Health Data Systems, each pharmacy service for a member is first assigned to a unique drug class called a DCC;

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2. DCCs to PRGs – DCCs for a member are further categorized into one of 120 initial pharmacy risk groups (PRGs). The PRGs are *markers* of member risk and combine DCCs of similar clinical and risk characteristics;
3. Additional PRGs – further PRGs are defined based on patient age and the combination of initial PRGs observed. These PRGs reflect co-morbidities or other characteristics that suggest a patient is of higher risk.
4. PRG Profile – Age, gender and mix of PRGs provide a clinical and demographic risk profile for a member. Members can be assigned zero, one, or more PRGs. Members with pharmacy treatments that indicate multiple medical conditions will have multiple PRGs;
5. PRG Risk Score – Using pre-determined weights and a member's PRG profile, a risk score is computed. A member's risk score is simply the sum of the weights attached to each PRG and demographic characteristic observed in their profile.

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### Symmetry's Drug Code Hierarchy – Mapping NDCs to DCCs.

- [0013]The National Drug Codes (NDCs) on a member's pharmacy claims provide a detailed description of their particular agents prescribed, including the labeler (manufacturer, packager, or distributor), the product itself (with strength, dosage and formulation), and how the drug is packaged. The details included in an NDC code are useful in many applications. However, the key information for health risk assessment comprises the general description of the agent itself, a description that can be linked to a therapeutic usage – the types of diseases and conditions for which it is typically prescribed. If a strong link can be established between an agent and therapeutic usage,

the drugs prescribed for a member can serve as a useful proxy for that member's overall morbidity and health risk.

[0014] A number of unique NDC codes are currently available to describe  
5 prescription drugs – too many groupings to support any practical approach to risk  
assessment. To categorize these codes, our method uses a robust, clinically-based  
classification system called the Drug Code Hierarchy. This system was initially  
developed by Symmetry Health Data Systems to support its Episode Treatment Group  
(ETG) methodology. Based on a series of clinical and statistical algorithms, ETGs  
10 combine inpatient and outpatient medical and pharmacy services into mutually  
exclusive and exhaustive categories called episodes of care. Examples of ETGs are  
insulin-dependent diabetes, with co-morbidity; congestive heart failure without co-  
morbidity; and ischemic heart disease, without AMI. Given its ability to categorize  
drugs for assignment to disease and condition episodes of care, the Drug Code  
15 Hierarchy provides a natural link between NDC code and therapeutic usage, a link that  
provides a sound basis for the development of a health risk assessment model.

[0015] FIG. 2 provides an example of the different levels of classification provided by  
the Drug Code Hierarchy. The lowest level is the NDC code. NDC codes map  
20 uniquely into Drug Class Codes (DCCs) that describe the general ingredient for the  
NDC. DCCs are further assigned to Pharmacologic Class (PCCs) and Therapeutic  
Class (TCCs). The PCCs and TCCs provide the link between the general ingredient  
described by an NDC code and the typical therapeutic use. In this example – for GI  
Agents – the three NDC codes for Protonix all map to DCC 44003 (Pantaprazole  
25 Sodium). That DCC and other selected agents map to PCC 440 (Proton Pump  
Inhibitors) which further are assigned to the GI Agents TCC.

[0016]Referring again to FIG. 1, in step 102, the method uses the Drug Code Hierarchy and maps all NDC codes for a patient to a unique DCC. We assume a 12-month *risk-marker* period for a member. All available pharmacy claims for the previous 12-months for a member are used for mapping to DCCs and creating markers of risk.

Pharmacy Risk Groups (PRGs) – Mapping DCCs to PRGs.

[0017]Referring again to FIG. 1, in step 104 the DCCs are mapped to PRGs. The DCC grouping provides a record of the different drug ingredients identified for an individual. A key step in developing PRGs is deciding how these DCCs can best be used as markers of risk. One option is to use all of the approximately 3,000 DCCs as separate risk markers. This approach is not preferred for several reasons. First, such a large number of risk factors would likely produce relatively small sample sizes for some markers, resulting in implausible or imprecise estimates of their contribution to risk. Further, the level of clinical detail provided by the DCCs could also produce imprecision due to the potential overlap in the impact of clinically-related agents on patient risk – over or underestimating risk for members with different combinations of these agents.

[0018]We combine DCCs into larger groups to create PRGs. In mapping DCCs to PRGs the primary goal is combining drugs of similar clinical and risk characteristics. Both clinical input and empirical evidence guide this process. The mapping involves a number of steps and assumptions:

[0019]DCCs indicating the same disease or condition and patients of similar risk are combined. To enhance both clinical relevance and also homogeneity in terms of risk, the grouping of DCCs occurred primarily within the same PCC and TCC – with all

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agents in most PCCs assigned to the same PRG. Exceptions include agents typically used to treat clinically diverse patients, patients of differing risk, or both. In these cases, DCCs within the same PCC are assigned to separate PRGs;

5 [0020]DCCs with relatively low prevalence were combined with other DCCs based on clinical similarity and implications for risk assessment;

[0021]PRG assignment does not vary with the number of DCCs or prescriptions observed for an individual within the same PRG. Patients with single or multiple agents or prescriptions within a PRG receive identical assignments. Further, for practical and other reasons, measures of dosage recorded on pharmacy claims, such as  
10 days supply and metric quantity, also do not impact PRG assignment;

[0022]Not all DCCs are used. Many agents have no measurable impact on future risk for a patient and are not assigned to a PRG. Further, to promote consistency, pharmaceutical agents not typically covered and provided through a prescription drug benefit are not used. Agents administered largely in an inpatient or facility setting or  
15 distributed primarily over-the-counter are examples.

[0023]Using this approach, a total of 107 PRGs have been initially identified. These PRGs are described in Table 1 (shown in FIGs. 3a-c). Note that further PRGs can be defined for a patient based on the combinations of these initial PRGs and other criteria (in step 106).

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### Additional PRGs.

[0024]Additional PRGs are defined based on observed combinations of the PRGs described in step 106. The majority of these added PRGs are designed to capture the impact on risk of a patient's co-morbidities. For example, a patient prescribed agents  
25 related to the treatment of coronary artery disease (CAD) who also has one or more prescriptions for insulin (suggesting diabetes) may have a different level of risk related



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to these agents than a patient with only the CAD agent or only insulin. A patient receiving multiple CAD-related agents from different PRGs is another example. For selected agents, separate PRGs were also defined depending on whether the age of the patient was 0-18 years or greater than 18, based on their differing impact on risk for children and adults. Glucocorticoid agents is one example. The final model includes 136 PRGs. The PRGs added or modified in Step 106 are noted in Table 1 with an asterisk (\*).

### PRG Profile.

[0025]Next, in step 108, a member's age, gender and mix of PRGs are used to create his or her PRG profile. Seven age groups are used for each gender for this purpose – 0-5, 6-11, 12-18, 19-34, 35-44, 45-54, and 55-64 years of age.

[0026]Every member is assigned to an age-sex group. Members can also be assigned to zero, one, or more PRGs depending on their mix of pharmacy agents. Members without pharmacy claims will have no PRGs. For these members, risk is based solely on age and gender.

### Measuring the Contribution of PRGs to Member Risk – PRG Risk Weights.

[0027]The next step 110 is the assignment of a weight to each PRG and demographic marker of risk to provide a risk score 112. These weights describe the contribution to risk of being in a specific age-sex group or having a particular agent included in a PRG. The model of risk can be defined as:

$$[0028]Risk_i = \sum a_s * a_{sex_i,s} + \sum b_e * PRG_{i,p}$$

[0029]where Risk<sub>i</sub> is the PRG risk score for person i; a<sub>sex<sub>i</sub>,s</sub> and PRG<sub>i,p</sub> indicate their age-sex group (s); and PRG (p) assignments, and the a's and b's are the risk weights. The age-sex and PRG markers are a series of 0,1 variables, set to 1 if the marker is

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observed for an individual, 0 otherwise. Each member has their own profile of age-sex and PRGs. However, the risk weights are pre-defined and are the same for all individuals. The risk weights are pre-set and delivered as part of the PRG software. Alternatively, PRG customers with large patient populations (greater than 500,000 members) might want to estimate weights using their own experience. A person's risk score is the sum of these risk weights for each marker observed.

[0030]The risk weights for PRGs are estimated using multiple linear regression and enrollment and pharmacy claims data for a large managed care population. These data are also used to test the predictive accuracy of the PRG model, as described below.

10 The PRG development data were obtained from the IHCIS National Managed Care Benchmarks Database.

[0031]Some applications of health risk assessment may require differing assumptions regarding the maximum dollar amount of interest for each member. To support this flexibility, PRG weights are estimated using different expenditure threshold assumptions. Expenditure threshold describes the level at which a higher-cost member's expenditures were truncated prior to deriving model weights. The application of a threshold amount has importance for several reasons. First, truncating expenditures for higher-cost members limits the impact of extreme outliers on model development and testing. Second, most applications of health risk assessment involve some use of a threshold or stop-loss. For example, when profiling the economic performance of primary care practitioners, some health plans will truncate expenditures for members with annual costs above some catastrophic amount, such as \$25,000. Payment or rate setting often includes some allowance for higher cost members, either explicitly as part of the rate setting process, or through reinsurance by health plans.

[0032]Thresholds of \$25,000, \$50,000, \$100,000 and \$250,000 can be used for

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estimating model risk weights. Costs for members with annual expenditures exceeding these amounts are truncated to the particular threshold for that analysis – for example, a member with annual costs of \$200,000 had their costs adjusted to \$100,000 for the \$100,000 threshold. PRG users can select one of these threshold options depending on their application.

[0033]Finally, health risk assessment typically focuses on projections of the relative health risk of total costs for a member, including all services. However, for some pharmacy-specific applications, users may desire an alternative outcome – member's health risk for pharmacy services only. To accommodate this, PRG users can select either total service costs (medical and pharmacy) or pharmacy costs alone as the outcome measured by the model. The same PRGs are used for each of these two outcomes and the different thresholds described above. However, the risk weights included in the model vary by both outcome and threshold selected.

[0034]Referring to FIG. 4, Table 2 provides examples of how PRG risk would be calculated for an individual – using the total cost outcome and a threshold assumption of \$250,000.

[0035]As shown, for Example 1, over a 12-month period, a male, age 58 was observed to have six unique DCCs, that map to four different PRGs – quinolones; antihypertensive agents; selected antiinfectives (macrolides); and antidepressants/antianxiety. (Note that the second anti-depressant (DCC 32001) does not add additional risk. Further, the prescription for ibuprofen does not contribute to risk, since that DCC does not map to any PRG.) The individual's age and sex and these four PRGs describe their profile of risk. The sum of the weights assigned to these risk markers provides the overall risk scores for the individual – separate risk scores for the retrospective and prospective models.

[0036]The scores in Table 2 reflect each individual's measure of risk relative to that

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of the overall population used in developing PRGs. A score of 1.00 indicates risk comparable to that of the development population, a score of 1.10 indicates 10 percent greater risk, 0.85, 15 percent lower risk, and so on. The 58-year-old male described in Table 2, Example 1 has a PRG prospective risk score of 2.2187 – indicating a level of  
5 future health risk more than two times that of the average for the large managed care population used in developing PRGs.

[0037]Example 2 shows a male, age 58 who prescription drugs translate into three unique DCCs, that map into three initial PRGs. These initial PRGs trigger a fourth PRG, based on the presence of both the carvedilol and insulin agents. This member  
10 receives separate risk weights for the carvedilol and the insulin PRGs and also receives a third weight due to the co-morbid PRG. Relative risk for this patient is 3.7602 – indicating a level of future health risk almost four times that of the average member.

[0038]Example 3 includes a 52 year old female with two DCCs. The first DCC,  
15 riluzole, maps to the PRG for agents used in the treatment of ALS. The second DCC describes an antidepressant. The risk weights assigned to these PRGs, along with the age-sex weight for the member, produce an overall risk score of 13.145, more than 13 times that of the average member.

[0039] Therefore, while there has been described what is presently considered to be  
20 the preferred embodiment, it will understood by those skilled in the art that other modifications can be made within the spirit of the invention.

We claim:

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Express Mail No. \*EV323492805US\*

Docket Number 069090.1